Joint Settlement Agreement between East Bay Municipal Utility District, U.S. Fish and Wildlife Service, and California Department of Fish and Game

This agreement protects and maintains the purpose of the EBMUD's Mokelumne River Project, protects the anadromous fishery and lower Mokelumne River ecosystem, and encourages cooperative action to achieve and maintain the objectives. The agreement contributes to the overall effort to improve the ecological health of the Mokelumne River Ecological Unit by establishing a $2 million partnership fund, encouraging voluntary participation of local interests, establishing a lower Mokelumne River stakeholders group, and recommending ecosystem protection and improvement priorities.

Efforts in the Eastside Delta Tributaries Ecological Management Zone will require cooperation from resource agencies, such as DFG, the California Department of Water Resources (DWR), California Department of Forestry and Fire Protection, State Water Resources Control Board, USFWS, USFS, U.S. Bureau of Land Management and the National Marine Fisheries Service (NMFS), as well as participation and support from the Corps, Reclamation, Natural Resource Conservation Service, other private organizations, water districts, and individual land owners. These groups are expected to work together to restore and maintain ecosystem health in this zone. This program may provide funding for the restoration measures included in the visions.

Central Valley Habitat Joint Venture

The Central Valley Habitat Joint Venture and the North American Waterfowl Management Plan have developed objectives for wetlands in the Eastside Delta Tributaries Ecological Management Zone. These objectives are consistent with the ERPP targets developed for this ecological management zone.

Linkage to Other Ecological Management Zones

The ecosystem health of the Eastside Delta Tributaries Ecological Management Zone depends on conditions in the Sacramento-San Joaquin Delta Ecological Management Zone. Because these tributaries are directly linked to the Delta, stressors there (entrainment, water quality) have a significant effect on resources, such as anadromous fish, in this zone. Conditions in San Francisco Bay and the Pacific Ocean can also have a significant effect on anadromous fish.

Reducing or eliminating stressors in the downstream ecological management zones will be important in restoring healthy fish and wildlife communities in the Eastside Delta Tributaries Ecological Management Zone.

Restoration Targets and Programmatic Actions

Ecological Processes

Central Valley Streamflows

Target 1: For the Cosumnes River, where a natural streamflow pattern presently exists with natural winter and spring streamflows, the target is to maintain or restore natural summer and fall base flows (◆◆).

Programmatic Action 1a: Improve summer and fall base flows on the Cosumnes River by developing new water supplies along the river and by purchases from willing sellers.

Programmatic Action 1b: Cooperatively develop a program to minimize or eliminate unpermitted water diversions on the Cosumnes River, and review water allocation for the entire basin.

Programmatic Action 1c: Cooperatively develop a groundwater replenishment program to raise the water table in the Cosumnes River floodplain.

Target 2: The target for the Mokelumne River is to provide conditions to maintain the fishery and riparian resources in good condition by implementing and evaluating the flow regime in the Joint

Settlement Agreement (JSA) for Mokelumne River. The JSA provides increased flows below Camanche Dam beyond present requirements, which will benefit the fishery and riparian resources of the lower Mokelumne River (◆◆◆).

PROGRAMMATIC ACTION 2A: Provide target flows for Mokelumne River storage releases, but only if there are sufficient inflows into storage reservoirs and carryover storage to meet target levels. The additional water would be obtained by developing new water supplies within the Central Valley basin, water transfers, and from willing sellers.

PROGRAMMATIC ACTION 2B: Maintain or enhance summer and fall base flows on the Mokelumne River by developing new water supplies and by purchases from willing sellers.

TARGET 3: The target also is to provide enhanced streamflows below Woodbridge Dam by providing minimum flows recommended by DFG in dry years: 200 cfs from November 1 through April 14; 250 cfs from April 15 through April 30; 300 cfs in May; and 20 cfs from June 1 through October 31. In normal years, minimum flows should be 250 cfs from October 1 through October 14; 300 cfs from October 15 through February 29; 350 cfs during March; 400 cfs during April; 450 cfs during May; 400 cfs during June; 150 cfs during July; and 100 cfs during August and September. In wet years, minimum flows should be 300 cfs from June 1 through October 14; 350 cfs from October 15 through February 29; 400 cfs in March; and 450 cfs during April and May (◆).

PROGRAMMATIC ACTION 3A: Cooperatively evaluate the potential for minimizing water supply impacts by replacing the diversions at Woodbridge with other Delta diversions.

PROGRAMMATIC ACTION 3B: Cooperatively develop a program to minimize or eliminate unpermitted water diversions on the Mokelumne River.

TARGET 4: A flow event should be provided on the Mokelumne River in late April or early May, averaging 500 to 1,000 cfs in dry years, 1,000 to 2,000 cfs in normal years, and 2,000 to 2,500 cfs in wet years (◆).

PROGRAMMATIC ACTION 4A: Develop a cooperative feasibility study of opportunities to provide spring flow events.

TARGET 5: For the Calaveras River, where the natural streamflow has been greatly altered, streamflows should be enhanced below New Hogan Dam by the minimum flows recommended by DFG (◆).

PROGRAMMATIC ACTION 5A: Provide target flows for the Calaveras River from storage releases, but only if there are sufficient inflows into storage reservoirs and carryover storage to meet target levels. The additional water would be obtained by developing new water supplies within the Central Valley basin, water transfers, and from willing sellers.

PROGRAMMATIC ACTION 5B: Cooperatively develop a program to minimize or eliminate unpermitted water diversions on the Calaveras River.

PROGRAMMATIC ACTION 5C: Cooperatively evaluate the potential for resizing criteria at New Hogan Reservoir on the Calaveras River to yield additional water for instream flow needs while maintaining or improving flood control requirements.

PROGRAMMATIC ACTION 5D: A flow event should be provided in late February or early March, averaging 100 to 200 cfs in dry years, 300 to 400 cfs in normal years, and 600 to 800 cfs in wet years. Such flows would be provided only when inflows to New Hogan Reservoir are at these levels

RATIONALE: *The proposed supplemental flows were selected as a representative value for impact analysis in the Programmatic EIS/EIR. Throughout the ERP, the need to determine optimal streamflow for ecological processes, habitats, and species is repeated. The issues of supplemental flows are complex in term of ecosystem improvements. The frequency, magnitude, duration, timing and rate of change of streamflows that form channels, create and maintain riparian habitat (including all species of vegetation), and promote all life stages of the various aquatic species dependent on a particular stream will never occur within a single year. An optimal flow regime will have to vary, perhaps significantly, from year to year. The supplemental flow recommendations will be an intensive exercise in adaptive management and must be based on credible scientific underpinnings.*

Inadequate instream flows have been identified as a limiting factor for anadromous fish and other aquatic resources in the eastside Delta tributary streams. For example, the Cosumnes River receives most of its water from rainfall due to the low elevation of its headwaters and the lower reaches of the river are often dry until the fall rains occur. As a result, adult fish must await the runoff following rains in late October and November before ascending to the spawning areas between Michigan Bar and Sloughhouse. Although there are no water storage reservoirs on the Cosumnes River, there are 157 registered appropriative water rights (U.S. Fish and Wildlife Service 1995). Most water is diverted from the first rains in the fall through early summer, coinciding with instream flow needs for fall-run chinook salmon. USFWS recommended an evaluation of instream flow requirement to ensure adequate flows for all life stages of all salmonids.

DFG (1993) recommended revised minimum flow schedules for the lower Mokelumne River. A Joint Settlement Agreement was signed in 1998 by EBMUD, CDFG, and USFWS that provides improved fish flows for the Mokelumne River, higher minimum flows below Camanche Dam, and gainsharing of additional flows between EBMUD and the Environment. It incorporates a broader ecosystem approach for managing the Mokelumne River resources.

The JSA flows for the Mokelumne River follow.

- *In normal and above normal water years, the agreed upon flows at Camanche Dam are 325 cfs from October 1 to June 30, 100 cfs in July, August, and September.*
- *In below normal years, the agreed upon flows at Camanche Dam are 250 cfs from October 1 through June 30, and 100 cfs in July, august and September.*
- *In dry years the agreed upon flows at Camanche Dam are 220 cfs from October 1 through May 31, and 100 cfs in June, July, August, and September.*
- *In critically dry years the recommended flows at Camanche Dam are 100 cfs from October 1 through 15, 130 cfs from October 16 through April 30, and 100 cfs in May, June, July, August, and September.*

Although the 1993 DFG flows for the Mokelumne River are presented as enhancement targets to be achieved when possible, these target levels need further review and should be a subject of adaptive management and focused research. The DFG flows were not developed with full consideration of upstream water quality, reservoir storage, and water temperatures, which need to be addressed for a finer assessment of water availability. The target flows, however, provide a possible target for further enhancement of the Mokelumne resource.

The Calaveras River drainage is almost entirely below the effective average snow level and thus receives runoff primarily as rainfall. Historically, the valley portion of the river commonly experienced periods of low or even no flow for many days or weeks in the late summer and early fall (California Department of Fish and Game 1993). Chinook salmon runs into the river were known to occur irregularly. There are currently no requirements to maintain flow releases for fishery purposes.

A preliminary instream flow study (U.S. Fish and Wildlife Service 1993) indicated that between 50 and 225 cfs, depending on time of year and water year type, is needed to provide spawning and rearing habitat for chinook salmon. A complete instream flow incremental methodology study is needed, however, to further define flow needs. Since the Calaveras River water supply is already over-allocated, the means of providing additional instream flows also need to be considered. The resizing of flood control criteria at New Hogan Reservoir has the potential to yield additional water to meet instream flow needs.

COARSE SEDIMENT SUPPLY

TARGET 1: On the Mokelumne River below Camanche Dam, provide average annual supplementation of 1,200 to 2,500 cubic yards of gravel into the active stream channel to maintain quality spawning areas and to replace gravel that is transported downstream (◆◆◆).

PROGRAMMATIC ACTION 1A: Develop a cooperative program to evaluate, implement, and monitor sediment supplementation on the Mokelumne River, consistent with adaptive management.

TARGET 2: On the Calaveras River, provide for the annual recruitment of 500 to 1,000 cubic yards of gravel into the active stream channel (◆◆).

PROGRAMMATIC ACTION 2A: Cooperatively develop a program to protect all existing gravel recruitment sources to the rivers.

PROGRAMMATIC ACTION 2B: Develop a cooperative program to supplement gravel with artificial introductions.

PROGRAMMATIC ACTION 2C: Develop a cooperative program with the aggregate (sand and gravel) resource industry to improve extraction activities within the Mokelumne River floodplain.

TARGET 3: Restore gravel transport and cleaning processes to attain sufficient high quality salmon spawning habitat in each of the three streams for target population levels (◆).

PROGRAMMATIC ACTION 3A: Develop a cooperative program to provide late winter or early spring flow events, as needed, to establish appropriate flushing/channel maintenance flows.

PROGRAMMATIC ACTION 3B: Facilitate fine sediment transport by restoring, as necessary, the river channel configuration so that it is consistent with planned flow regime and available sediment supply.

PROGRAMMATIC ACTION 3C: Develop a cooperative program to improve the flexibility of upstream reservoir management to minimize fine sediment inputs to the lower Mokelumne and Calaveras Rivers.

PROGRAMMATIC ACTION 3D: Develop a cooperative evaluation of mechanically cleaning spawning gravel at selected sites in lower Mokelumne and Calaveras rivers.

PROGRAMMATIC ACTION 3E: Develop a cooperative program on the Cosumnes River to relocate sand and gravel extraction activities to areas beyond the natural stream meander corridor.

TARGET 4: Restore channel gradient and stream profile in the Cosumnes River between Twin Cities Road and Highway 16 (◆◆).

PROGRAMMATIC ACTION 4A: Develop a cooperative program to assess the feasibility of reversing head cutting and stream channel incision in the Cosumnes River.

RATIONALE: *Recruitment of suitable salmonid spawning gravel below Camanche Dam on the Mokelumne River is minimal. Most gravel present is in the small range of the preferred sizes used by spawning chinook salmon. Targeted levels are to maintain processes linked to sediment supply, stream channel meander, and riparian and riverine aquatic habitat. This program will be subject to adaptive management, focused research, and monitoring, and thus is considered short-term until a more detailed evaluation is completed.*

Flood stage for the lower Mokelumne River is 5,000 cfs. Preliminary data suggest that spawning-sized gravel for adult salmonids (DFG 1991, Bjorn and Reiser 1991) do not begin moving in the lower Mokelumne River until flows of 3,000 cfs or more are reached (Envirosphere 1988). Even at 5,000 cfs (flood stage), the larger gravel does not move. Significant impacts occur to property along the lower Mokelumne River at flows above 2,500 cfs. It would not be practical to place supplemental gravel along the entire reach of the lower Mokelumne River because numerous roads would have to be constructed for access. The environmental impact of these roads would negate any benefit from the addition of spawning gravel. Therefore, a gravel supplementation program on the Mokelumne River would have to be long-term and gravel injected at the upper end. Lower gravel enhancement sites were established below Highway 88 at Mackville Road on the lower Mokelumne River in 1997 and 1998. These sites are approximately 5 miles below Camanche Dam.

Flow regulation has reduced the frequency and magnitude of high flow events in the lower Mokelumne River. Due to the reduction in high flows and excessive input of fine sediments, sediments accumulate in salmonid spawning gravel and degrade habitat. BioSystems (1992) reported that over 70% of the substrate samples taken in 1991 and 1992 from chinook salmon redds contained amounts of fine sediment less than 0.48 mm in diameter, which is detrimental to egg survival (Chapman 1988). The need for salmonid spawning gravel restoration is also identified by DFG (1993) and USFWS (1997).

Gravel supplementation programs should be subject to adaptive management, monitoring, and focused research. The frequency and amount of supplemental gravel will vary greatly from year to year. Physical monitoring can record observable changes in the size and distribution of gravel, while biological monitoring can record use of new gravel by anadromous fish and invertebrates. Focused research is needed to calculate annual bedload movement, gravel quality, infiltration, and intragravel water quality.

Mechanical means to clean gravel should be evaluated. This could be a focused research project. Due to water quality constraints and the presence of juvenile anadromous and other fish species, the window for gravel cleansing may be short. This concern should be included in the feasibility analysis.

NATURAL FLOODPLAIN AND FLOOD PROCESSES

TARGET 1: Restore and improve opportunities for rivers to inundate their floodplain seasonally (◆◆◆).

PROGRAMMATIC ACTION 1A: Conduct a feasibility study to construct setback levees in the Mokelumne River floodplain in the area from Elliot Road to Woodbridge and from Woodbridge to the mouth, including the Mokelumne forks below the river's mouth.

PROGRAMMATIC ACTION 1B: Restore, as needed, stream channel and overflow basin configurations within the floodplain.

PROGRAMMATIC ACTION 1C: Minimize effects of permanent structures, such as bridges and diversion dams, on floodplain processes.

PROGRAMMATIC ACTION 1D: Develop a floodplain management plan for the Mokelumne River.

PROGRAMMATIC ACTION 1E: Develop a floodplain management plan for the Calaveras River.

PROGRAMMATIC ACTION 1F: Develop and implement a cooperative program to evaluate the feasibility of reconnecting the Cosumnes River to its historical floodplain in areas where the river has become entrenched.

PROGRAMMATIC ACTION 1G: Cooperatively develop and implement a feasibility study on the Cosumnes River to identify opportunities to improve sediment transport, stream meander, and maintain the natural flow pattern.

RATIONALE: *Setback levees will provide greater floodplain inundation, room for stream meander, and greater amounts of riparian forest and seasonal wetland habitats along the lower rivers. Channel configuration adjustments may be necessary to accelerate restoration of natural floodplain habitats and to restore and maintain configurations that may not occur naturally due to remaining constraints from new setback levees. Permanent structures, such as bridges and diversions dams, can interrupt and impair natural floodplain processes and habitat development and succession, thus requiring removal of the structures, rebuilding, or some continuing maintenance or mitigative efforts to minimize their effects. Some reaches of the Cosumnes River upstream of Twin Cities Road have become entrenched and even setback levees will not raise the level of the river bed to the point where the historical floodplain is again functional. This requires a feasibility analysis to identify causes of the stream channel degradation and identification of potential remedial measures.*

The value of floodplain inundation to native fish species is extremely high. Recent studies have provided more insight to the value of the Cosumnes River floodplain to splittail spawning and rearing and chinook rearing.

CENTRAL VALLEY STREAM TEMPERATURES

TARGET 1: Maintain mean daily water temperatures at or below levels suitable for all life stages of fall-run chinook salmon and steelhead (◆◆).

PROGRAMMATIC ACTION 1A: Cooperatively evaluate the feasibility of releasing sufficient instream flows to improve temperature conditions for key resources in the Mokelumne and Calaveras Rivers.

PROGRAMMATIC ACTION 1B: Establish minimum pool size at New Hogan Reservoir to ensure cold-water releases into the Calaveras River.

PROGRAMMATIC ACTION 1C: Cooperatively develop reservoir and stream temperature models for

the Calaveras River to identify potential for water temperature improvement.

PROGRAMMATIC ACTION 1D: Manage Pardee and Camanche Reservoirs through October to maintain a cold water volume of 28,000 af when Pardee Reservoir volume exceeds 100,000 af.

RATIONALE: *Water temperatures in the lower Mokelumne, Calaveras, and Cosumnes Rivers are often at stressfully high levels for fall-run chinook salmon early in the spawning run, and again in the spring when young salmon are migrating downstream to the Delta. The problem is especially acute downstream of Camanche Dam, where water temperature depends on release temperature, prevailing weather conditions, and flow rate. From April to mid-October, the closure of Woodbridge Dam and subsequent filling of Lake Lodi results in the slowing of flow, allowing the water to warm. Differences in water temperature between Camanche and Woodbridge Dams have been measured up to 16.2°F during dry years (Walsh et al. 1992). Higher flow, colder water, and riparian woodlands may reduce this water heating during the fall upstream spawning run and spring downstream migration of young to the Delta.*

Releases of Pardee Reservoir water into Camanche Reservoir should coordinated to maximize the effectiveness of the Camanche coldwater pool. Timely releases of cold water from Pardee Reservoir can extend the period and increase the value of coldwater releases from Camanche Reservoir.

Water temperatures in the Calaveras River are closely associated with instream flows, reservoir release schedules, and pool size at New Hogan Reservoir (U.S. Fish and Wildlife Service 1993). Temperatures often exceed stressful or lethal levels for chinook salmon migration, spawning, egg incubation, and rearing. An improved temperature regime could be achieved by maintaining a minimum pool at New Hogan Reservoir and adequate instream flow releases (U.S. Fish and Wildlife Service 1993). The appropriate minimum pool size needs to be determined. Reservoir and stream temperature computer models are also needed to identify the potential for maintaining suitable water temperatures for chinook salmon and to weigh the conflict between coldwater releases and loss of carryover storage necessary to provide coldwater releases later in the season or the following year(s).

Riparian woodlands along all three rivers are essential for shade to minimize heating of the rivers. This is especially important along the Cosumnes River, because there is no source of cold reservoir bottom water as there is below Camanche and New Hogan Reservoirs.

HABITATS

GENERAL HABITAT RATIONALE

Restoring seasonal wetland habitats along with other aquatic, permanent wetland, and riparian habitats is an essential element of the restoration strategy for the Eastside Tributaries Ecological Management Zone. The ecological units in this zone are closely linked to the Sacramento/San Joaquin Delta Ecological Management Zone, particularly the East Delta Ecological Unit. The lower sections of the Eastside ecological units overlap the East Delta Ecological Unit so it is important to consider habitat restoration recommendations in the Delta when evaluating needs in the Eastside Tributaries. For example, the following programmatic actions apply to the East Delta Ecological Unit:

- *restore 1,000 acres of shallow-water habitat (tidal perennial aquatic habitat) at the eastern edge of the East Delta Ecological Unit,*
- *develop 200 acres of open-water areas (nontidal perennial aquatic habitat) in the East Delta Ecological Unit,*
- *develop 300 acres of shallow, open-water areas (nontidal perennial aquatic habitat) within restored fresh emergent wetland habitat in the East Delta Ecological Unit,*
- *in the short-term, restore 10 miles of slough habitat and 30 miles in the long-term in the East Delta Ecological Unit,*
- *restore tidal action to portions of islands and tracts in the East Delta Ecological Unit with appropriate elevations, topography, and water-landform conditions,*
- *develop tidal freshwater marshes (fresh emergent wetland habitat) along the upper ends of dead-end slough in the East Delta Ecological Unit,*

- *restore 1,000 acres of nontidal freshwater marshes (fresh emergent wetland habitat) in leveed lands designated for floodplain overflow adjacent to the dead-end sloughs in the East Delta Ecological Unit,*
- *restore and manage at least 6,000 acres of additional seasonal wetland habitat and improve management of 1,000 acres of existing, degraded seasonal wetland habitat in the East Delta Ecological Unit,*
- *restore 8 to 15 miles of riparian and riverine aquatic habitat in the East Delta Ecological Unit of which 40% is more that 75 feet wide and 20% over 300 feet wide,*
- *develop a cooperative program to restore 1,000 acres of perennial grassland in the East Delta Ecological Unit through either conservation easements of purchase from willing sellers, and*
- *generally, cooperatively manage agricultural lands in a wildlife friendly manner.*

SEASONAL WETLANDS

TARGET 1: Protect existing seasonal wetland habitat (◆◆).

PROGRAMMATIC ACTION 1A: Develop and implement a cooperative program to improve management of existing, degraded seasonal wetland habitat.

PROGRAMMATIC ACTION 1B: Identify and acquire seasonal wetland habitat from willing sellers through acquisition or easement.

RATIONALE:*Restoring these habitats will also reduce the amount and concentrations of contaminants that could interfere with restoring the ecological health of the aquatic ecosystem. Seasonal wetlands support a high production rate of primary and secondary food species and large blooms (dense populations) of aquatic invertebrates.*

Wetlands that are dry in summer are also efficient sinks for the transformation of nutrients and the breakdown of pesticides and other contaminants. The roughness of seasonal wetland vegetation filters and traps sediment and organic particulates. Water flowing out from seasonal wetlands is typically high in foodweb prey species concentrations and fine particulate organic matter that feed many Delta aquatic and semiaquatic fish and wildlife. To capitalize on these functions, most of the seasonal wetlands of the Eastside Delta Tributaries Ecological Management Zone should be subject to periodic flooding and overland flow from river floodplains

RIPARIAN AND RIVERINE AQUATIC HABITATS

TARGET 1: Restore a minimum of 1,240 acres of self-sustaining or managed diverse natural riparian habitat along the Mokelumne River, and protect existing riparian habitat (◆◆◆).

PROGRAMMATIC ACTION 1A: Develop a cooperative program to restrict further riparian vegetation removal, and establish riparian corridor protection zones.

PROGRAMMATIC ACTION 1B: Develop a cooperative program to implement riparian restoration activities.

PROGRAMMATIC ACTION 1C: Encourage improved land management and livestock grazing practices along stream riparian zones.

PROGRAMMATIC ACTION 1D: Purchase streambank conservation easements from willing sellers to widen riparian corridors.

PROGRAMMATIC ACTION 1E: Develop a cooperative program to restore riparian woodlands along the entire Mokelumne River.

TARGET 2: Restore a minimum of 1,240 acres of self-sustaining or managed diverse, natural riparian habitat along the Calaveras River, and protect existing riparian habitat (◆◆◆).

PROGRAMMATIC ACTION 2A: Develop a cooperative program to restrict further riparian vegetation removal. Establish riparian corridor protection zones along all three rivers.

PROGRAMMATIC ACTION 2B: Develop a cooperative program to implement riparian restoration activities.

PROGRAMMATIC ACTION 2C: Encourage improved land management and livestock grazing practices along stream riparian zones.

PROGRAMMATIC ACTION 2D: Purchase streambank conservation easements from willing sellers to widen riparian corridors.

PROGRAMMATIC ACTION 2E: Develop a cooperative program to restore riparian woodlands along the entire Calaveras River.

TARGET 3: Restore a minimum of 1,240 acres of self-sustaining or managed diverse, natural riparian habitat along the Cosumnes River, and protect existing riparian habitat (◆◆◆).

PROGRAMMATIC ACTION 3A: Develop a cooperative program to restrict further riparian vegetation removal, and establish riparian corridor protection zones.

PROGRAMMATIC ACTION 3B: Develop a cooperative program to implement riparian restoration activities.

PROGRAMMATIC ACTION 3C: Encourage improved land management and livestock grazing practices along stream riparian zones.

PROGRAMMATIC ACTION 3D: Purchase streambank conservation easements from willing sellers to widen riparian corridors.

PROGRAMMATIC ACTION 3E: Develop a cooperative program to restore riparian woodlands along the entire Cosumnes River.

RATIONALE: *The DFG is developing a strategy to establish a stream corridor protection zone on the Cosumnes River to prevent incompatible land use from affecting existing salmonid habitat. In addition, The Nature Conservancy is targeting the restoration of more than 7,000 acres. The 1,240 acres recommended for restoration under Target 3 are to be compatible with ongoing restoration efforts. Generally, the 1,240 acres represents a 100 foot-wide riparian corridor along 10 miles of stream. The site specific refinement of this target will likely occur in collaboration with the partners of the Cosumnes River Project.*

Riparian vegetation along the lower Mokelumne River is diminishing (U.S. Fish and Wildlife Service 1993), however, EBMUD and the Natural Resources Conservation Service are developing a strategy for establishing a stream corridor protection zone on the lower Mokelumne River. In many areas, there is no regeneration along the relatively thin riparian corridor (California Department of Fish and Game 1991). Riprapping long sections of streambank has reduced tree growth and decreased stream shading, resulting in increased stream temperatures (East Bay Municipal Utility District 1994). Bankside erosion has potentially affected salmonid production in several areas where livestock grazing is permitted.

FRESHWATER FISH HABITAT AND ESSENTIAL FISH HABITAT

TARGET 1: Maintain and improve existing freshwater fish habitat and essential fish habitat through the integration of actions described for ecological processes, habitats, and stressor reduction or elimination (◆◆).

PROGRAMMATIC ACTIONS: No additional programmatic actions are recommended.

RATIONALE: *Freshwater fish habitat and essential fish habitat are evaluated in terms of their quality and quantity. Actions described for Eastside Delta Tributaries Ecological Management Zone ecological processes, stressor reduction, and riparian and riverine aquatic habitat should suffice to maintain and restore freshwater fish habitats. For example, maintaining freshwater and essential fish habitats is governed by actions to maintain streamflow, improve coarse sediment supplies, maintain stream meander, maintain or restore connectivity of streams in this zone and their floodplains, and in maintaining and restoring riparian and riverine aquatic habitats.*

STRESSORS

WATER DIVERSION

TARGET 1: Install fish screens representing the best available technology and operational constraints, as necessary, to minimize losses in diversions that limit the recovery of fish populations (◆◆◆).

PROGRAMMATIC ACTION 1A: Consolidate diversions, seek alternative water sources, and install a permanent fish screen at North San Joaquin Conservation District diversion on the lower Mokelumne River.

PROGRAMMATIC ACTION 1B: Improve fish screens and the fish bypass system at Woodbridge Dam on the lower Mokelumne River.

PROGRAMMATIC ACTION 1C: Evaluate the feasibility of installing state-of-the-art screens on small pump diversions.

PROGRAMMATIC ACTION 1D: Develop a cooperative program to operate temporary screens at diversions where juvenile salmon rear or during seasons when they pass the diversion site.

PROGRAMMATIC ACTION 1E: Consolidate and install screens on diversions in the Cosumnes River.

RATIONALE: *On the lower Calaveras River, most of the existing diversions are not screened or are inadequately screened (California Department of Fish and Game 1993). Nearly all water in the river is diverted, especially in the summer and fall of drier years. During the winter and spring, unscreened diversions between the spawning areas and the river mouth are a potential threat to juvenile salmon.*

Stockton East Water District has an appropriative water right to divert up to 100 cfs from the Calaveras River. This diversion is currently unscreened. There are several other unscreened diversions along the river. It is probable that juvenile salmon losses occur during years when chinook salmon enter and spawn in the Calaveras River (California Department of Fish and Game 1993).

On the lower Mokelumne River, more than 90 pumps withdraw water from the river between Camanche Dam and the Delta. Few, if any, are screened to prevent fish entrainment (BioSystems 1992). The Woodbridge Irrigation District (WID) diversion at Woodbridge Canal allows juvenile chinook salmon and steelhead losses, because the screen does not meet present DFG criteria for approach velocity and mesh size, nor does it effectively screen the opening of the diversion (California Department of Fish and Game 1993). North San Joaquin Water Conservation District is the second largest diversion below Camanche Dam; temporary fish screens were installed in 1993 (U.S. Fish and Wildlife Service 1995).

Most Cosumnes River diversions are unscreened and likely entrain juvenile salmonids (U.S. Fish and Wildlife Service 1995).

Screening or eliminating diversions from areas where juvenile salmon are rearing or actively migrating will increase production of naturally produced juvenile salmon from these three streams.

DAMS AND OTHER STRUCTURES

TARGET 1: Improve anadromous fish passage at dams and diversion structures (◆◆◆).

PROGRAMMATIC ACTION 1A: Develop a cooperative program to evaluate the need for passage improvements at small dams on the lower Cosumnes River.

PROGRAMMATIC ACTION 1B: Cooperatively improve fish passage at WID diversions and Lake Lodi on the lower Mokelumne River.

PROGRAMMATIC ACTION 1C: Cooperatively isolate the City of Lodi's Recreational Lake Lodi on the lower Mokelumne River to improve adult salmon and steelhead passage and juvenile fish survival.

PROGRAMMATIC ACTION 1D: Develop a cooperative program to provide fish passage at temporary irrigation dams in the Calaveras River, Mormon Slough, and the Stockton Diverting Canal.

PROGRAMMATIC ACTION 1E: Develop a cooperative program to install fish passage facilities at Bellota Weir, Clements Dam, and Cherryland Dam on the Calaveras River, and provide passage flows.

RATIONALE: *Small flashboard dams and some illegal dirt and gravel dams exist on the lower portions of the three rivers (U.S. Fish and Wildlife Service 1997). These dams may impede up- and downstream chinook salmon migration. On the lower Mokelumne River, Woodbridge Dam and the WID diversion may kill fish or delay downstream migrating juvenile salmonids and upstream passage of adult salmonids. DFG (1993) and USFWS (1997) recommended evaluating improvements to the existing fishway on Woodbridge Dam.*

An informal inspection of Granlees Diversion Dam by DFG in 1998 suggested that the ladder design is deficient. In addition to this dam, there are three concrete summer dams/low flow crossings in the lower Cosumnes River, well below the chinook salmon spawning area. The Fisheries Foundation of California and the DFG identified these to be low flow barriers to upstream migration. Minimum estimated flows needed for passage in this area is approximately 150 cfs.

The channels that carry Calaveras River water, and are migratory routes for salmon below Bellota Dam,

include the original Calaveras River stream channel, Mormon Slough, and the Stockton Diverting Canal (into which drains Mormon Slough) (California Department of Fish and Game 1993). In some years, typically in March, partial or complete blockage of the adult salmon migration coincides with the annual placement of approximately 30 temporary irrigation dams in these channels. Fish are prevented from reaching the deep holding pools and spawning gravel above Bellota and are subjected to poaching below the flashboard dams. Reclamation Board Permit No. 7594 (August 27, 1971) requires that some of the flashboards and slide gates be removed from the channel prior to November 1 of each year and not replaced before April 15. Two of the diversion structures, Clements Dam and Cherryland Dam, have been identified as barriers to salmon movement and require fish passage facilities. The Bellota Dam (weir) has also been known to block upstream salmon migrants at flows below approximately 200 cfs (California Department of Fish and Game 1982). In some years, salmon have been observed in the tidewater reach, apparently unable to move upstream at lower flows. Juvenile salmon have trouble finding the downstream outlets to the dam and fish ladder.

Invasive Riparian and Marsh Plants

Target 1: Reduce the adverse effects of invasive riparian plants on native species and ecosystem processes, water quality and conveyance systems, and major rivers and their tributaries (◆◆).

Programmatic Action 1a: Develop and implement a coordinated control program to reduce or eliminate invasive plant species from the riparian corridor along the Cosumnes, Mokelumne, and Calaveras Rivers.

Rationale: *Non-native plant species, such as Arundo, also known as giant reed or false bamboo, can be highly invasive, fast-growing plants that outcompete and displace native riparian vegetation. These plants restrict water flow, increase sedimentation, and form large debris piles in streams and rivers. Arundo has been introduced into the watersheds of the Eastside Delta Tributary Ecological Management Zone. Its presence is impairing existing riparian communities and will likely hinder riparian corridor restoration. Riparian regeneration programs will require a coordinated approach to controlling invasive or non-native species through public education and chemical, biological, and mechanical methods.*

Predation and Competition

Target 1: Reduce predation level on juvenile salmonids below Woodbridge Dam on the lower Mokelumne River (◆◆◆).

Programmatic Action 1a: Develop a cooperative program to modify the stream channel and rebuild the Woodbridge Dam fish passage and diversion screening facilities. This will help minimize losses of downstream migrating salmon and steelhead, while maintaining other important functions.

Programmatic Action 1b: Modify and improve the fish bypass discharge at Woodbridge Dam.

Rationale: *High spring flows attract striped bass, American shad, and squawfish to the base of Woodbridge Dam on the lower Mokelumne River. Studies suggest that a significant proportion of the juvenile salmon smolt production in the Mokelumne River basin may be lost to predation (Boyd 1994, East Bay Municipal Utility District 1994). Juvenile salmon must first pass the reservoir, then the dam, and then the predators concentrated immediately below the dam (striped bass and American shad are unable to ascend the ladder and move upstream; therefore, they tend to gather in large numbers below the dam).*

Contaminants

Target 1: Restore and maintain water quality in Camanche Reservoir on the Mokelumne River (◆).

Programmatic Action 1a: Support EBMUD in developing operating procedures at Pardee and Camanche Reservoirs that optimize water quality below Camanche Dam.

Programmatic Action 1b: Support implementation of the cooperative agreement for the long-term remediation of Penn Mine contamination.

Target 2: Reduce the input of nonpoint source contaminants into the Mokelumne River (◆◆).

Programmatic Action 2a: Develop an integrated program to coordinate and minimize